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Contents.

	PAGE
The Vagaries of the Foundry	375
Cores *versus* Drawbacks	376
The Toughness of Steel	376
The New Foundry of the Shelton Iron, Steel and Coal Company, Limited, Stoke-on-Trent	377
The "Pneulec" Roll-over Moulding and Core-making Machine	378
Uses and Abuses of Moulding Sands	379
Electric Tool-Steel	380
The Analysis of Coke	381
Temperature Problems in the Foundry	382
Use of Micrography in Aluminium-Bronze Foundry Practice	382
A Fly-Wheel Problem	383
Stainless Steel	384
Correspondence	385
The Origin of Defects in Tube Rolling	386
A Journal of Scientific Instruments	386
Rapid Electro-Analysis of Brass	386
Trade Talk	387
J.B.F. President's Visit to the States	387
Company News	388
Publications Received	388
Gazette	388
Deaths	388
Personal	388
Installation of Machinery for the Birmingham Exhibition	388
Iron and Steel Markets	390

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE
INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

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The Vagaries of the Foundry.

In the preparation of our Special Number, which is to be published on June 15, we have had the opportunity of examining some of the most modern labour-saving contrivances yet devised for the improvement of foundry plant and conditions.

Changing over from this, we read a Paper by M. Thomas on "Modern Tendencies Governing the Lay-outs of Foundries," given before the French Association Technique de Fonderie, wherein it is stated that not very long ago the author came across a foundry (presumably in France) where the moulders had to walk across an open yard for a distance of over 300 yards to fetch their green sand; and, what is worse, to fetch their metal from the cupola, they had to be preceded by a youth holding a smoky oil lamp in order to see their way sufficiently clear. Whilst we hope that no such conditions operate in this country, we would point out that there do still exist here in Great Britain shops, of a most antiquated nature, devoid of any modern plant and containing everything inimical to best foundry practice. Leaking roofs, doors serving as windows, heavy lifts accomplished by pulley blocks, cupola entirely in the open air, no machines, an antiquated home-made core stove, and a heterogeneous collection of badly-made moulding boxes, is a description applicable to some of the shops desecrating the good name of the foundry and hounding apprentices into other industries.

Foundry specialists will immediately classify the shop as a jobbing foundry doing a local trade, and indicate that they don't count. Unfortunately, they do! They, of course, lend themselves to comparison between a country blacksmith's shop and a modern engineering works, but with this difference, that the sphere of the shoeing-smith's shop is well defined, and he offers no competition to anything worthy of the name of an engineering works, but quite often it is found that these small jobbing shops, possessing only the haziest notion of costing, often decide to compete for repetition jobs, which owing to the meagreness of the overhead charges seem profitable, but lack of facilities often causes wasters totally unprovided for.

The other side of the picture is again brought forcibly to mind by the souvenir booklet of the annual conference of the Institute meeting at Birmingham. So excellent is this production that anybody unacquainted with the vagaries of the foundry trade would imagine that it referred to the most up-to-date of modern industries. The advance copy which we have received made us, as it will all those members who are fortunate enough to be able to take part in the forthcoming conference, feel proud, because one cannot help imagining that an industry capable of producing such a brochure associated with all it contains is capable of much more than it has to show to-day. The book contains some 60 pages, and is artistically bound in stiff grey backs. As a foreword a welcome is given to the visitors. Then follows in the following order a list of the members of the Conference Reception Committee, the general and detail arrangement of the Conference, visits, excursions, works visits, details of the Foundry Trades Exhibition, and an important section on the growth of the Institution. An interesting section is devoted to the metallurgical development of Birmingham. Mr. Thos. Vickers, who is responsible for its production, is to be congratulated on the excellence of the booklet. It is a model which future conference secretaries will find difficult to emulate.

WE would again remind members of the Institution that any good organisation is more or less watertight, and that which has been arranged at Birmingham is of this nature. We are personally aware of several members who intend participating, but they are holding back from pure laziness, and this to their own detriment. Probably they object to closing their mould until they are just ready for casting. This attitude may be quite good in the foundry itself, but its effect on those who are organising for a meeting of any nature is most disconcerting, and reacts not only against the stragglers but against the visitors at large. *Fill up your form to-day.*

Cores versus Drawbacks.

BY F. C. EDWARDS.

Since improvements or greater facilities in one direction often permit material economic changes to be made in another, frequent overhauling of methods in the light of latest practice would seem to be the price of existence.

These remarks apply with special force to the foundry, particularly in regard to the question of cores versus drawbacks. By resorting to drawbacks the skilled craftsman can solve practically every problem in moulding. Incidentally, pattern-shop delinquencies are occasionally rectified in this way. Nevertheless, except in special cases, cores are almost invariably preferable to drawbacks. With the advent of the oil-sand core, of course, their advantages over drawbacks are even more pronounced. For example, an ordinary dry-sand or loam core of moderate size might take, say, two hours to make and a dozen hours to dry. Whereas the same core in oil-sand would probably be made in half-an-hour and would dry in three or four hours.

This remarkable advance in core production must have a far-reaching effect on foundry practice generally. Methods that were formerly considered the most economical will now be looked upon as extremely wasteful.

Consider briefly the sequence of operations in making the drawback for the case illustrated in Fig. 1. The foot shown is one of several on the

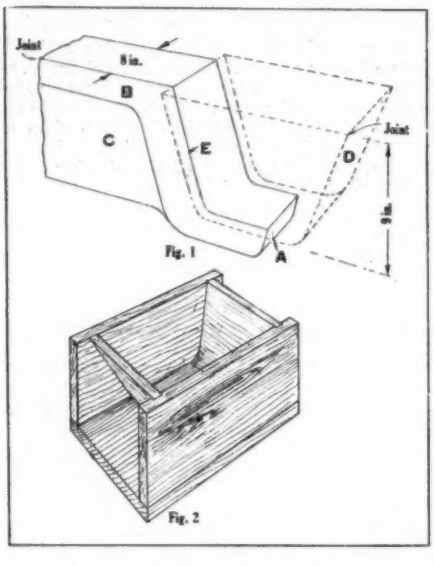


Fig. 1

Fig. 2

pattern, which, together with other circumstances, decides that it must be moulded in the position as drawn, *i.e.*, face "A" downwards. The pattern is embedded in the floor, and the mould is rammed up level with its upper surface, marked "joint" in the figure. The top box part is staked in position, rammed up, and removed. A hole—virtually a sand core-box—approximating in shape to that shown in dotted section, is then dug out. In the bottom of this hole is placed a plate with a lifting rod attached (not shown in the sketch). The hole is rammed up—for the second time, be it noted. The sides of the drawbacks are then cut away to facilitate its removal. The drawback—or green-sand core, as it is alternatively called—is lifted out, and the pattern withdrawn. The mould is finished and the drawback is returned to its position.

Compare the method of coring. In the first place, the pattern is stronger, since the top plate, B, and rib C may be carried to the extremity of the print—shown in dotted section. This leaves a substantial block, into which a good-sized rapping plate is screwed. Obviously, no amount of rapping can distort a pattern made in this manner. It may be observed that the end of the print, D, is tapered exactly the same as the face of the casting, E. Whichever way the core is set in the mould, it will thus be correct. Fig. 2 shows the corebox, made, by the way, so that the core is rammed up in the same position as it is lowered into the mould. In moulding the job, no second ramming up of the feet is needed. The pattern, having been withdrawn, the cores are lowered into the accurately-fitting prints.

Although drawbacks vary considerably in shape and application, the above principles are generally applicable. That they are, as a rule, wasteful expedients, is realised when it is remembered that a temporary sand corebox must be made every time a drawback is resorted to. From a wooden corebox, on the other hand, thousands of identical cores may be made.

The Toughness of Steel.*

BY J. C. W. HUMFREY, O.B.E., M.Sc.

The Paper described the testing of steel for toughness by means of notched-bar test-pieces, and examples were given indicating how such tests are capable of revealing certain properties not shown by the usual tensile test. The general practice has been to break notched-bar test-pieces by means of a blow in an impact machine, and to take the total energy absorbed in deformation and fracture as a measure of the toughness. A new notch-bar testing-machine was described, designed by the author, in which the stress is applied gradually, and which autographically records the relation between bending moment and bending angle throughout the test. Experiments with this machine have indicated that materials can be classified into two distinct groups: (1) Those in which fracture, when once started at the bottom of the notch, takes place gradually, and the material offers a definite resistance to the propagation of the crack; and (2) those in which fracture occurs suddenly, and the crack is rapidly propagated through the specimen without the applications of further external forces.

It is suggested that this difference is a better indication of toughness or brittleness than the figure for the total energy as obtained in an impact machine. The property of gradual or sudden fracture appears, to a great extent, to be independent of the speed of the deformation which precedes it, or of the form or sharpness of the notch.

The case of carbon steels was considered in detail, and it was shown that brittleness (*i.e.*, sudden fracture of the notched-bar test-piece) may be due either to the lack of normal adhesion between the crystals or the cleavage weakness in the crystals themselves. When a sudden failure occurs it is accompanied by a shattering effect occurring in advance of the main crack. In medium and high-carbon steels brittleness may result from the normal structure of the pearlite, in which brittle cementite lamellæ are embedded in allotriomorphic ferrite crystals. The ferrite tends to deform by slip, but such slips fracture the cementite lamellæ and lead to the rapid formation of cracks.

It was shown how heat treatment may so modify the relative structure of ferrite and pearlite or the inner structure of the pearlite itself as to produce very marked variations in toughness.

Practical heat treatment of carbon steels was considered, and reference made to the Sandberg sorbitic processes as applied to rails and tyres.

Views were expressed that, although toughness is very frequently absent from many materials which, nevertheless, give satisfactory service, yet if present it would undoubtedly lessen the chances of sudden failure in articles containing flaws or cracks formed either during manufacture or under unusual service conditions.

The Paper was illustrated by autographic charts of notched-bar tests and by photomicrographs.

IRON AND STEEL INSTITUTE.—In accordance with the announcement at the annual meeting, arrangements have been made to hold an adjourned meeting in the Mappin Hall of Sheffield University, by kind permission of the Vice-Chancellor, for the purpose of continuing the discussion on Mr. Fred Clements' Paper on "British Siemens Furnace Practice."

* Abstract of a Paper read before the Birmingham Metallurgical Society.

The New Foundry of the Shelton Iron, Steel and Coal Company, Limited, Stoke-on-Trent.

We are indebted to the Editor of the "Indented Bar Bulletin" for permission to reproduce the following article.

With the exception of parts of the roofing material this building is constructed entirely in reinforced concrete, and contains several points of interest.

The main foundry occupies the centre of the building, which is 125 ft. long and 40 ft. wide. An extension on one side, 100 ft. long by 20 ft. wide, 20 ft. 6 in. high at the outer edge, and 30 ft. where it joins the main building, accommodates the small casting foundry and the brass foundry, the former being open from the main foundry and the latter enclosed. On the other side of the building an extension 38 ft. long by 17 ft. wide, 16 ft. in height on the outside and 24 ft. at the junction with the main building, provides accommodation for the sand mixer and core makers' department.

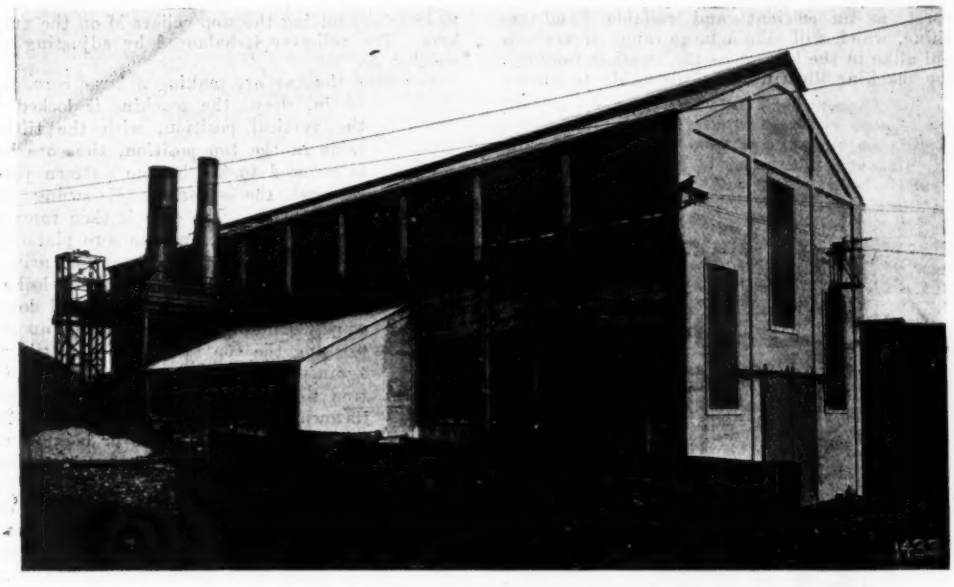


FIG. 1.—NEW FOUNDRY AT STOKE-ON-TRENT.

FIG. 2.—INTERIOR OF MAIN FOUNDRY, SHOWING ROOF TRUSSES AND BEAMS.

The overall height of the structure is 53 ft. The columns of the main foundry are 18 in. by 12 in. in section spaced at 12 ft. 6 in. centres, resting on pyramidical footings 3 ft. 6 in. deep expanding from the section of the column to 5 ft. square.

A crane beam, 29 ft. from the ground, is supported direct by these columns, and the upper portion of the columns which carry the roof trusses is set back 17 in. from the inner face of the lower part of the columns and reduced in section to 15 in. by 12 in. Where no walling is inserted between the columns horizontal ties 12 in. by 6 in. are provided to ensure stability.

The four columns at the ends of the main building are similar in section to the intermediate columns, with the exception of the extended portion from the crane beam level, which in these four instances measures 32 in. by 12 in. in section. The columns supporting the walls of the extensions are all 14 in. by 8 in. in section, supported on pyramidical footings 4 ft. by 2 ft. in plan at the base. These columns are tied to the main columns by horizontal members and sloping rafters, each 12 in. by 6 in. in section, and spanning the width of the extension.

The roof of the main foundry is supported on trusses measuring 44 ft. overall, having a clear span of 41 ft. 6 in. These trusses are composed of a bottom tie 8 in sq. in section, a post of similar section, and sloping rafters 15 in. by 8 in. The height of the trusses overall is 12 ft.

The ridge beam extending along the tops of the trusses is 12 in. by 6 in. in section, and the purlins at the eaves level 8 in. by 6 in.

The crane beams are both 33 in. by 10 in. in section, and designed to carry a travelling crane with a lifting capacity of 30 tons spanning across the width of the building.

The walls are in all cases carried down to 1 ft. below the existing ground level, and are 6 in. thick at the base, decreasing in the first 7 ft. of their height to 4 in., which thickness remains constant above that level.

The floor level in the foundry is 6 ft. above ground level outside; there is a depth of 6 ft. of sand in the main bay, and 3 ft. in the small casting foundry.

The sand filling of the floor, of course, reduces the apparent height of the building, and it is perhaps noteworthy that except where the side extensions occur the main columns are unsupported for a height of 40 ft. 9 in.

The wall at one end of the building is a temporary one, so as to allow for extension at some future date.

The illustrations show the excellent lighting effect in the interior of the building, the majority of the wall space being taken up by very large window casements.

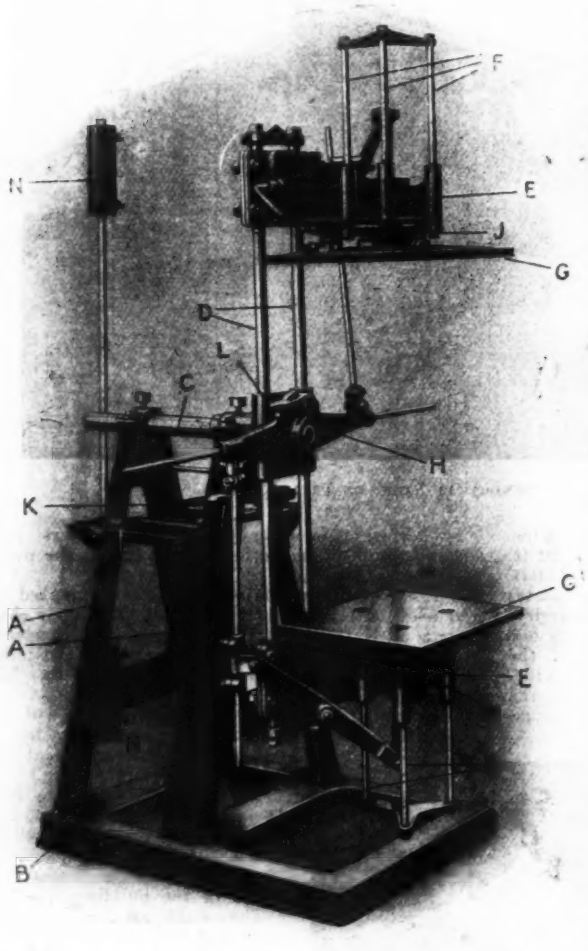
The work was designed by the engineer to the

Shelton Company, and was carried out by the Broadway Construction Company, Limited, of Westminster. The designs for the reinforcement, which consisted of indented bars, were prepared by the Indented Bar & Concrete Engineering Company, Limited.

The "Pneulec" Roll-over Moulding and Core-making Machine.

The machine illustrated will be of very general interest, as an efficient and reliable hand-ram machine, which will take a large range of work, is useful alike in the largest as the smallest foundry.

The machine illustrated is adaptable to almost any class of work, particularly to jobs which have deep green-sand cores to be withdrawn and require a deep pattern draw, whilst it will take boxes 10 in. × 10 in. × 3 in. up to 24 in. × 30 in. 18 in. × 18 in.



The Pneulec Roll-over Moulding and Core-making Machine.

The principle of the machine and its method of operation will be understood by reference to our illustration.

The two stands A-A are mounted upon the base-plate B. On top of the stands is a shaft C capable of rotating in its bearings. Connected at right angles with the shaft are two steel guide bars D, each of which carries an extension arm E. The arms can be moved to any position along the bars and locked in that position, so that for a shallow box it is only necessary to bring the arms in towards the centre, or for a very deep box to take them out towards the ends. The upper extension arm is made to swing clear of the machine, and so is out of the way of the operator when moulding.

The pattern-plates G are secured to the extension arms E by the guide bars F. The plates are raised or lowered through a link motion by the operating lever H. The upper plate is made to tilt in any direction, and can be locked in any desired position by the lock screws J. This table tilting is an extremely useful feature, as it enables uneven boxes or core plates to be used, whilst, of course, it obviates the necessity of having boxes planed on both sides.

The machine is kept from rotation while the mould is made by a plunger bolt operated through K. The pattern-plates are raised and lowered simultaneously by the handle H, being locked in any position by a pawl and ratchet movement. A further feature is that the depth of the pattern draw can be stopped at any distance from 1 in. to 18 in. by setting the stop collars M on the guide bars. The roll-over is balanced by adjusting the weights N.

Assuming that we are making a large core, say, 15 in. deep, the machine is locked in the vertical position, with the tilting table in the top position, the core box is screwed to the bottom pattern plate G, and the extension E swung out of the way. The core is then rammed up, strickled off, and the core plate put on top, the upper extension arm is swung back into position and locked. The operating lever is now pulled downwards, bringing the bottom table up and pressing the top table, which is tilting, against the core plate. As the table is free to move in any direction it finds its own level and is then locked by the screw J, the operating lever being similarly locked by the pawl and ratchet. The catch K is then released, and the whole job swung over, thus bringing the tilting table into the bottom position. The pawl is now released, and the operating lever gently raised, thus lifting the core box from the core, and at the same time dropping the core away from the core box on the core plate ready to be carried away.

It will be obvious that the machine requires no foundation or fixing in any way; indeed, it is sufficiently light as to be readily portable. It is worthy of note, also that the ramming table, when in a position for moulding, is at a very convenient working height, approximately only 24 in. from floor level, whilst as one movement of the operating lever brings both plates towards the centre there is no necessity for either clamping the mould to the pattern plate, or the core plate to the core box.

The machine is being made in two standard sizes by the Pneulec Machine Company, Limited, Roebuck Lane, Smethwick, Staffs.

Ferro-Uranium.

The following process is being used for the manufacture of ferro-uranium, according to the "Journal du Four Electrique," at Joachimstahl, in Czecho-Slovakia. First of all, pitch-blende is calcined in order to expel the sulphur and arsenic, then the mineral is melted with charcoal in an electric furnace, when the uranium passes into the slag together with the tungsten, molybdenum and vanadium. This slag is then heated with carbon to obtain the carbides, from which boiling water can separate the uranium. The uranium carbide is then dried and calcined. Ferro-uranium can be made in a crucible or metallic uranium by one of the alumino-thermic methods.

The John Surtees Memorial Competition for medals will be held at Newcastle in December next. It is this year confined to the members, associate members, and associates of the Newcastle branch of the Institution of British Foundrymen.

Uses and Abuses of Moulding Sands.*

By EUGENE W. SMITH.

Sand for foundry use is a subject about which very little information can be obtained from books or technical papers. This probably is due to the fact that each foundryman requires a material best suited to the class of castings he is to produce. Different methods of moulding—floor moulding, bench moulding, hand rammed and air pressed machine moulding—require different grades, as also do heavy and light castings, castings which require a fine finish and those in which finish is unimportant.

Steel, malleable iron, cast iron and brass, melted at different temperatures in the order named, require different refractory conditions in the sand. Gases generated in different lines require varying conditions of porosity. Both conditions are governed by the silica content of the sands selected. As the silica content is increased the sand is weakened. In castings where there are deep pockets or close corners to be lifted, a greater bond is required. This bond is controlled by the varying alumina or iron oxides. The predominance of either may be noted by the colour, iron giving the red and alumina the yellowish shades

sand is too strong or new it burns on the casting, causing waste. Excessive use of sea-coal facing very often weakens the sand, the unburned portion in the moulds after a short time destroying the bond by coating each grain with carbon. The sand becomes a deep black, whereas the natural colour of burned sand is red. This condition can only be overcome by addition of a bonded sand.

Another weak condition comes from constant use of a sand for heavy castings, the bond being carried away with the casting and renewal being necessary. When an excess of core sand drops from the castings into the heap, increasing the silica, the sand is weakened and an increased bond is needed. As said before, silica is a weakener of sand, but is very necessary in the mould to create porosity to carry away the gases.

When castings are taken out of the sand and the sand is not sufficiently well knocked off the very best portion of the riddled sand is carried away and wasted. A common practice of pouring surplus metal into sand heaps causes a waste both of sand and of labour handling the metal. It is far better to furnish ingot moulds for this purpose. Still another common practice of burning out, thawing or drying out new sand by pouring metal into it is extremely wasteful both of metal and sand.

Sometimes a sand is highly recommended by one

TABLE I.—*Showing the Properties of a few American Moulding Sands.*

	Opener.	Binders.		Of no particular Moulding value.				Texture and Finish.	
	SiO_2, Per cent.	Fe_2O_3, Per cent.	Al_2O_3, Per cent.	CaO, Per cent.	MgO, Per cent.	Alkalies, Per cent.	SO_2, Per cent.	Fineness.	
Tennessee	92.96	3.10	4.92	—	—	0.26	—	98.58	Fine Weak Open.
Long Island, N.Y.	89.16	2.92	4.66	—	0.33	0.33	—	0.53	Coarse Weak Open.
New York ..	82.34	4.24	8.50	0.96	0.40	1.79	0.54	1.70	Coarse Strong Open.
Indiana	82.50	2.70	8.90	0.16	0.61	1.47	—	0.59	Coarse Strong Open.
Wisconsin	82.87	2.67	8.45	0.80	0.89	1.00	Trace	57.3	Medium Strong Open.
Indiana	79.66	9.74	3.36	1.34	0.68	2.50	—	78.34	Medium Strong Open.
South Carolina ..	79.30	4.10	10.70	1.19	1.29	—	—	—	Strong Open.
Kentucky	76.16	4.24	12.02	—	0.72	1.21	—	—	Open Fine Strong.
Ohio	77.14	6.44	9.20	Trace	0.91	1.10	—	—	Strong Open.
Illinois	75.70	13.46	3.00	0.60	1.08	2.15	0.19	0.60	Coarse Strong Close.
Illinois	56.80	5.09	14.43	6.40	5.60	3.15	0.14	70.24	Fine Strong Very close

Summing up the foregoing, there are but two conditions required: Bond and porosity, alumina and silica, or in simpler words, clay and sand; for example, lake sand, almost entirely silica, and clay for brick and tile purposes, mainly alumina, neither being suitable for moulding. Other oxides appear to have no particular value for moulding purposes, lime in particular being detrimental to the finish of the casting in some lines. The finish is controlled by the texture or grain of the sand. The fineness is determined by running the sand through a series of sieves ranging from 10 mesh to 100 mesh.

No foundryman should confine himself to one grade of sand. At least two grades should be carried, one high in bond or alumina, the other high in silica for use in opening up sands when losses occur from blow, etc., and for facing purposes on heavier lines of work. The high alumina sands are to be added to the moulding sand as a binder when it has been weakened by constant use or from other causes.

A good moulding sand is often condemned on account of abusive practices by the foundryman. The excessive addition of new sand will invariably cause loss, both of castings and sand. Where

foundryman to another as having given him wonderful results. Its appearance being favourable, a supply is ordered without considering that his own work is heavier, the result being that the sand is soon burned out and weakened, with a consequent loss of product. Thus it is very apparent that one standard will not suit all lines of work.

A study of Table I. should show the variation met with in all moulding sands. It would be a very desirable feature if all sands sold could be accompanied by a standard analysis. This should particularly apply to blended or milled sands where the texture has been changed and sometimes an otherwise unsuitable sand is made to appear satisfactory.

The present practice of selling and purchasing moulding sands appears very crude. Small spoonful samples are shown by the salesman and are supposed to represent the contents of carloads to be shipped. The purchaser squeezes it into a ball to test the bond and finish by "feel," and sometimes puts it to his ear and rubs it to test its openness by "sound." All that is left for him to do is to taste it. If the Bureau of Standards, universities and technical men can devise some form of table, such as is presented here in an incomplete shape, it would prove a great help both to the producer and consumer.

* Extracted from a Paper presented before the Chicago Foundrymen's Club.

DISCUSSION.

Among those who participated in the discussion were R. A. Bull, research director the Electric Steel Founders' Research Group, Chicago, and chairman of the Joint Moulding Sand Research Committee of the American Foundrymen's Association and the National Research Council, who outlined the broad scope of the work undertaken by his committee and told of the progress which had been made up to date. The committee comprises 37 members and has had one meeting thus far, while various sub-committees have met several times. The first step in the investigation, the preparation of a bibliography, has been completed. This was done by the secretary of the committee, R. E. Kennedy, who is also assistant secretary to the American Foundrymen's Association. He not only listed all articles which have been written on the subject of sand and sand tests, but has abstracted all information which might be of use to the committee.

The importance of the work undertaken by the committee is indicated by the fact that $7,500,000 was spent in 1920 for moulding sand alone. Mr. Bull stated that the problem confronting the investigators was particularly difficult because no standards have been established by which to gauge the quality and suitability of various sands for different purposes and no satisfactory tests have been devised for ascertaining such standards. The next step in the work, he said, would be on the subject of tests. The committee has found, for instance, that even tests for fineness are not uniform. Sieves may have the same number of meshes per square inch, but owing to the fact that there is a difference in the diameter of the wires, the results from different tests are not conclusive. The personal equation in sifting also prevents accuracy in fineness testing.

It is difficult also to determine the percentage of moisture in sand, and even when it is determined it does not always have the same significance. It has been found, for instance, that it is better to store high bond sand in a moist atmosphere than to permit it to dry out and then to restore the moisture subsequently. The reason for this is not yet clear.

A satisfactory test for bond is also lacking. One method is to push a bar of sand over the edge of a table and measure the length of the portion which drops off. Others take the weight of the portion which drops, but in either case much depends upon the surface of the table top, the speed at which the bar is moved and the friction between the bar and the table.

These are just a few of the problems confronting the committee. Mr. Bull stated that one important result of the investigation would be to make available to the foundry industry many sand deposits which have not yet been exploited. A number of important sources of supply, he stated, would soon be exhausted, and heretofore there has not been much investigation of new deposits. When suitable standards have been devised, however, State geologists will be able to locate new deposits suitable for moulding use.—"Iron Age" Report.

Electric Tool-Steel.

A Paper, entitled "The Present and Future Scope of the Electric Furnace in the manufacture of Tool-Steel," was read by Mr. F. Rowlinson, at a meeting of the West Yorkshire Metallurgical Society held at Leeds on April 1. The author, in discussing the selection of materials to be melted in the production of tool-steel, the melting practice employed, and the inherent limitations and characteristics imposed by the furnace and melting apparatus, remarked that the crucible steel industry was nearly two hundred years old, and it was noteworthy that during the whole period an outstanding feature of the crucible trade had been the great care and discrimination used in the selection of materials for melting. The old crucible-steel makers were under no delusions on the point. Chemical refining never troubled them; they knew that when quality went in, quality came out; and so they chose their materials from the best in the world; the best steel-making Swedish irons, the best Sheffield blister bar, every piece hand-fractured and graded, the best Swedish white irons, and the best Sheffield tool scrap. All these materials, of unsurpassed purity and quality, were chosen, and no others. The best crucible steel to-day was still made from the materials chosen more than a hundred years ago. The crucible-steel industry had been called conservative, apathetic, but the fact still remained that to this day the finest tool steel in the world, Sheffield's crucible steel, was made only from the most expensive materials of unquestioned purity and quality. Chemical guidance was absent when tool-steel first began to be manufactured, and but little was needed to-day. Where no impurities went in, no chemical means were necessary to take them out again.

From time to time various processes had aspired to displace the crucible by substituting inferior materials and refining them to give a high-grade product. Bessemer and open-hearth steel were used in Sheffield, but the product was distinctly third grade.

Electric tool-steel melters had endeavoured to reduce the expense of selected high-grade materials by refining in the electric furnace material of only moderate purity, and they had produced a steel which, in analysis and appearance, was exactly equivalent to the best crucible steel; but trial soon showed that it was deficient in quality, and it lacked that indefinable "body" possessed by a high-class crucible steel. The claims that the electric furnace could be charged with any old scrap, provided it was steel, and that by clever chemical manipulation and elaborate refining a tool-steel of the finest quality could be produced, had done incalculable harm. Electric tool-steel makers were realising every day that the electric furnace must be regarded as an apparatus for melting only, if it is to produce a high-grade tool steel.

Various objections had been put that the high temperature of the arc in an electric furnace led to deterioration of the metal, but even expert opinion could give no adequate explanation of this. In any case the metal was protected by a good blanket of slag. The crucible furnace was completely sealed except when the lid was removed for pottering or additions. This led to a very slight oxidation of the charge, say three or four points of carbon. Exactly similar conditions applied to the electric furnace. This also could be completely sealed except for the necessary working; a slight initial oxidation of about three points of carbon gave place to a reducing atmosphere far more intense than that of the crucible. In this respect conditions were similar in both processes; in fact, the electric furnace should show a slight superiority, due to the better reducing conditions, the basic hearth and slag and sulphur.

Steel made to this schedule should be cast in top-cast ingots, wide-end up with a funnel runner, and a generous hot top or dozzle. Ingots should be as large as possible for the class of work for which they were required and should be reasonably uniform in size for any one plant.

Concluding, the author remarked that as no saving was permissible in materials charged or in care in operation, it was obvious that the electric furnace must seek to justify itself by economic advantages in other ways. This would be secured by handling high-grade steel in larger quantities by melting in hundredweights instead of pounds, by higher thermal efficiency. In general, economy must be sought by applying quantity methods and appliances to quality production. The furnace should be at least 30 cwts. capacity or 10 cwts. for high-speed and similar steels. The charge of selected materials should be heavy stock, of which 25 per cent. should be heavy first-grade tool-scrap. No ore additions, mill scale, or other boiling agents must be permitted, and no slagging. Carburation should be by the finest carburising agents, no solid carbon or grey iron permitted. No ladle additions should be made except a little aluminium, and a white slag should be attained, and kept for at least an hour before tapping. Heats of the second or third-grade should be either degraded first quality heats, or heats with slightly inferior melting stock. Second-grade heats might be permitted a little refining, third-grade heats rather more with more latitude in the ladle additions.

The Analysis of Coke.

BY ARTHUR GROUNDS, B.Sc.

The sampling and analysis of coke calls for the use of methods entirely distinct from those which are used in the analysis of the raw coal from which the coke has been manufactured.

Sampling.

The coke is sampled in the usual way until a representative quantity has been obtained for despatch to the laboratory. Special precautions are, however, necessary for the reduction of this bulk sample to the size necessary for analysis. The coke is usually glass-hard, and it is therefore especially liable to become contaminated by abrasion of the surface on which it has been crushed. J. Hughes stated, in the "Gas World" for February 1, 1919, that the ash content of a certain delivery of coke was reported by different analysts at figures varying between 1 and 5.6 per cent. Such wide differences can only be the result of contamination of the sample during grinding. If an iron pestle and mortar are used, for the coke picks up a certain quantity of fine iron, which can be separated by magnetic means, and this iron may amount to as much as 12 per cent. This abrasion occurs during the conversion of the coke from small pieces to a fine powder, and to avoid such error it is advisable to place the coke in lumps in a linen bag and to break it up whilst enclosed in the bag to the state of a coarse powder, and to finish the grinding in an agate mortar.

Moisture.

In the calculation of blast-furnace charges, the estimation of moisture is of importance. Mr. W. C. Gillhausen calculated that the extra consumption of coke per 100 tons of pig-iron amounted to 450 kilos per charge (0.443 ton) for every 1 per cent. increase in moisture, taking 1.263 tons of coke, containing 11.54 per cent. of ash and 11.72 per cent. of moisture, for the production of one ton of pig-iron. It has also been shown that the presence of an undue amount of water in the coke may lower its crushing strength by as much as 14 per cent. The attrition loss, due to handling, also increases with increasing moisture content, and it is therefore apparent that great care is necessary to arrive at the correct moisture content before making any definite statements concerning the quality of a consignment. It is also essential to obtain a thoroughly representative sample, as the moisture content of the small coke of a truckload may be 12 times as great as that of the large coke. The outer layers of the larger pieces also generally contain much more moisture than the inner layers, and in a Paper by W. H. George, in the "Journal of the Society of Chemical Industry," 1919, p. 394, it is shown that the ratio of the moisture in the small coke to that in the large coke may vary between 1.2 and 9.5, whilst the ratio between the moisture in the outer layer of the large pieces to that in the inside of the pieces lies between 1.9 and 11.3. The sample should weigh about 14 lbs., and should consist of about 20 separate portions. It is quite impracticable to guarantee the result of the moisture content determination to 0.1 per cent., although such figures are often given, but the result should be quoted to 0.5 per cent., which is sufficiently accurate for most foundry purposes. The sample should be mixed with the least possible delay, and care should be taken during the grinding that loss of moisture by evaporation is reduced to the minimum. Coke is not subject to the same limitations as coal when estimating moisture, and is capable of stronger heating without undergoing oxidation. The method adopted by the author is to take 10 to 20 grammes in a large circular silica dish and dry at 110-115 deg. C. in the drying oven for 1½ hours; then cool in a desiccator and weigh. For rough determinations, the coke can be weighed as carefully as possible into a tared bucket and dried over a boiler, or other suitable place on the works plant. For very accurate determinations, the coke should be weighed into a porcelain boat, which is placed in a tube provided with a glycerine and water jacket, and which is heated to 110 deg. C., dried air being passed over the coke for an hour.

Ash.

The ash content of a coke should be determined by weighing out 1 to 2 grammes of the coke into a porcelain boat, which is then placed in a ⅝-in. hard-glass tube. The tube is heated to a red heat (about 650 deg. C.) and oxygen is passed slowly over the coke to avoid loss by spitting. When the combustion is complete, the boat is removed and weighed, and the difference between this weight and the weight of the empty boat gives the weight of the ash. This is a much better method than ignition in a silica or platinum dish over an ordinary bunsen flame, and is much more rapid.

Sulphur.

Sulphur can be conveniently estimated in the liquor remaining in the bomb after determination of the calorific value in the bomb calorimeter. The oxygen should be admitted at 25 atmospheres pressure, and a little water should be placed in the bottom of the bomb. The liquor is rinsed out after the determination has been made, and is diluted to 100 ccs., the solution being brought to the boil; 10 ccs. of barium chloride solution are then added and the liquid is kept at the boiling point for two minutes, and is then placed on the corner of a hot plate to stand for an hour or two. When the barium sulphate has settled out, it is filtered off through a Whatman No. 42 filter paper, washed with hot water, dried and ignited. The paper should be separately ignited from the precipitate, and when the ignition is complete, two drops of dilute sulphuric acid should be added to convert any barium sulphide (produced by reduction of the sulphate by the charred filter paper) to sulphate. From the weight of barium sulphate, the weight of sulphur in the original coke is easily calculated.

The sulphur can also be estimated by Eschka's method. For this purpose, one gramme of the coke is weighed out into a platinum crucible and 5 grammes of a mixture of two parts of light magnesia to one part of sodium carbonate are added. The mixture of finely powdered coke, magnesia and sodium carbonate is then thoroughly stirred by means of a silica rod, until the colour of the mass is uniform, and the top of the mixture is then sprinkled with another gramme of the Eschka mixture. The crucible is then heated over an alcohol flame (from a spirit lamp), in order to avoid contamination from the coal gas supply, until bright red, and is then maintained at that temperature until all the organic matter has been burned off. The crucible is then allowed to cool and is subsequently placed in a beaker containing 150 ccs. of water. In order to avoid loss of sulphur in the form of sulphuretted hydrogen when acid is added, the addition of 10-15 ccs. of bromine water is made, to oxidise all the sulphur present. Hydrochloric acid is then added to dissolve all the magnesia and sodium carbonate, and when solution is complete, 10 ccs. of a saturated solution of barium chloride is added, the solution having been brought to the boil. The beaker is then allowed to stand, and when the barium sulphate has completely separated out, it is filtered off through a Whatman No. 42 paper, dried and weighed as described in the last paragraph. The weight of barium sulphate, multiplied by 0.1374, gives the weight of sulphur in the coke taken.

A blank determination should always be made on the components of the Eschka mixture, as it is very difficult to obtain magnesia entirely free from sulphur.

More recently, Parr has described a method for determining sulphur very quickly by fusion of the coke with sodium peroxide in the Parr bomb. This is a crucible of almost identical shape with the crucible used in the Roland Wild calorimeter. The mixture of 0.5 gramme of coke and 9 to 10 grammes of sodium peroxide is put into the bomb and the latter is then heated with a blow lamp or Meker burner. The fusion is complete in about half a minute and the bomb is then cooled under the tap and is extracted with water. The subsequent process is similar to that for the Eschka method, namely, treatment with hydrochloric acid and barium chloride. This is probably the most rapid method for the estimation of sulphur.

Phosphorus.

Certain cokes are often liable to contain excess phosphorus, and this is, of course, a vital factor in the character of the finished iron. The phosphorus can be determined by ashing a known weight of the coke and fusing one gramme of the

ash with 3 grammes each of sodium and potassium carbonates, free from phosphorus. The fusion is extracted with hydrochloric acid, and is made just alkaline with dilute ammonia, the hydrates of iron and alumina being filtered off and washed. The precipitate contains the whole of the phosphorus as phosphorus pentoxide, and is redissolved either in concentrated hydrochloric acid or in dilute (1 : 20) nitric acid, and the solution is treated with 15 ccs. of ammonium nitromolybdate solution. The liquid is shaken round, and is then left on a fairly cool corner of the hot plate for 15 to 20 minutes until the yellow precipitate settles to the bottom of the beaker on standing for a short time. The precipitate is collected on a hardened filter paper and is washed with a 2 per cent. nitric acid solution. The precipitate is then washed from the paper into a tarred platinum dish and is carefully dried and weighed as ammonium phospho-molybdate. The phosphorus content of the coke can be calculated by taking 1.65 per cent. of the weight of the precipitate. This represents the phosphorus in 1 gramme of the ash.

Calorific Value.

The calorific value of the coke is best determined by ignition in the bomb calorimeter, but where such an instrument is not available it may be approximately determined by means of the formula: $H = 146.7\ C + 220\ V$, where C is the fixed carbon in the dry coke, and V is the volatile matter. The calorific value is then expressed by H as B.Th.U.'s per lb. of dry coke. In this connection a graph has been drawn up by K. Norton, and was published in the "Gas World" for 1919, p. 165, whereby the calorific value for all cokes of volatile matter up to 15 per cent. and ash content up to 20 per cent. is given. The volatile matter is best determined by the standard American method, *i.e.*, by heating 1 gramme of the coke, finely powdered, for seven minutes in a platinum crucible weighing 20 to 30 grammes, over a bunsen flame 18 cms. high, the base of the crucible being 7 cms. above the nozzle of the burner. The crucible is then removed and cooled, and when cool is weighed. The loss in weight gives the volatile matter.

Temperature Problems in the Foundry.*

By JOHN P. GOHEEN.

Considerable work has been done in developing a pyrometer to measure the temperature of molten brasses, bronze, and aluminium in the crucible. On account of the high melting points and the amount of zinc and sulphurous fumes given off from molten brasses, the conditions are somewhat severe for a thermocouple of standard design; but satisfactory results are obtained with a portable pyrometer, 3 ft. of connecting lead wire, and a special 5-ft. nickel-nickel chromium thermocouple, composed of rods ¼-in. in diameter. The portable instrument need not be of the extreme high-resistance type, as the movable parts of the galvanometer of a lower resistance instrument may be better constructed to withstand the continuous handling such an instrument receives. Platinum-platinum rhodium thermocouples, protected with porcelain and graphite tubes, have been used, but the lag in registering the temperature is too great.

It has been found that the range of temperature for various brasses is from 1,200 to 1,400 deg. C. The temperatures of molten aluminium under varying conditions range from 690 to 835 deg. C. To insure consistent pouring temperatures, the temperature at the furnace and the distance to the moulds must be regulated. The size of the crucible also must be considered, as a much slower rate of cooling prevails with the larger crucible of metal.

A permanently installed 60-day continuous recording electric pyrometer may be placed on electric brass-melting furnaces, and an actual record secured of the temperature of each melt and the time interval.

The thermocouple consists of extra heavy ¼-in. nickel-nickel chromium rods, similar to those used with portable pyrometers. These thermocouples are protected against the severe gases by heavy porcelain tubes, which in turn are inserted in fire-brick tubes closed at one end. Platinum-platinum rhodium thermocouples were tried, but the tilting of the furnace when pouring caused the lighter gauge wire to break. Besides, the gases caused crystallisation. The nickel-chromium as well as the platinum-rhodium thermocouple must be carefully protected to resist a zinc-oxide precipitation from the fumes of the brass at time of pouring.

In the manufacture of bow sockets for automobile use, the difficulty of brazing the socket was overcome when the temperatures in the furnace and the effect of air drafts in re-charging the furnaces were regulated.

To determine the relative flame temperature and brazing temperature, a duplex recording pyrometer having a chart divided into two sections was installed near the furnaces. Two 18-in. platinum-platinum rhodium thermocouples in fused silica quartz tubes were connected to the recorder, using compensating leads direct to the recording instrument. One of the thermocouples was inserted in the hollow tube close to the eyelet of the socket to be brazed, a mixture of borax and brass filings having been poured down the tube as a brazing flux. It was found that the actual temperature of the furnace and of the couple were very close. The thermocouple was then removed from the tube and permanently located just to one side of the other burner, so that the hot end was in immediate juxtaposition to the sockets. It was found that a window immediately above the furnace, when open, permitted the air to be drawn into the furnace; an asbestos curtain was installed to prevent this.

Two galvanometer systems of several hundred ohms resistance, one for each section of chart, are mounted in grey-iron casting, machined and enamelled. As the thermocouples are connected by wire directly to each electrical system, there are no rotating switches to develop poor contact. A continuous roll of carbon ribbon produces a non-smearing dot every 30 sec., which permits the slightest change in temperature to be shown. Thermocouples of base metal or rare metal may be used.

The durability of the thermocouples depends greatly on the type of protecting tube selected. In galvanising tanks, using a high percentage of zinc, a test was made recently of nine types of tubes closed at one end. After two months' continuous immersion, all but two of the tubes were entirely eaten through by the action of the zinc; one was of wrought iron with extra heavy wall; the other was a Resisteat tube composed of a high chromium-iron alloy. The wall of the wrought-iron tube was quite thin, but the Resisteat tube showed very little effect.

* Abstract of a Paper read before the Spring Meeting of the American Institute of Mining and Metallurgy.

Use of Micrography in Aluminium-Bronze Foundry Practice.*

The alloy specifically dealt with consists of copper of 10 per cent. and aluminium 90 per cent.; it is very suitable for commercial purposes, as it combines lightness with high resistance to corrosion at ordinary temperatures, and can withstand higher temperatures up to 950 deg. C. The authors discuss its properties, including reaction to tempering. The solidus-liquidus diagram is given for the whole range of Cu-Al. With the 90 :10 alloy the chief practical difficulties arise in the foundry, from three main properties, namely, low range between the molten and the solid states, rapidity of crystal growth, and considerable shrinkage. These difficulties interact to the disadvantage of the foundryman. Metal poured hot develops large crystal growth, involving brittleness; metal poured cold is liable to cold shuts; large feeding-heads are desirable, but will not give sound castings where considerable change of section is involved. Instances are discussed where the latter difficulty has been modified by the use of chills in the mould; the results are discussed and illustrated by macrographs of sections of the castings obtained.—J. GALIPBOURG and A. BRIZON (*Rev. Met.* 18, 780-786.)

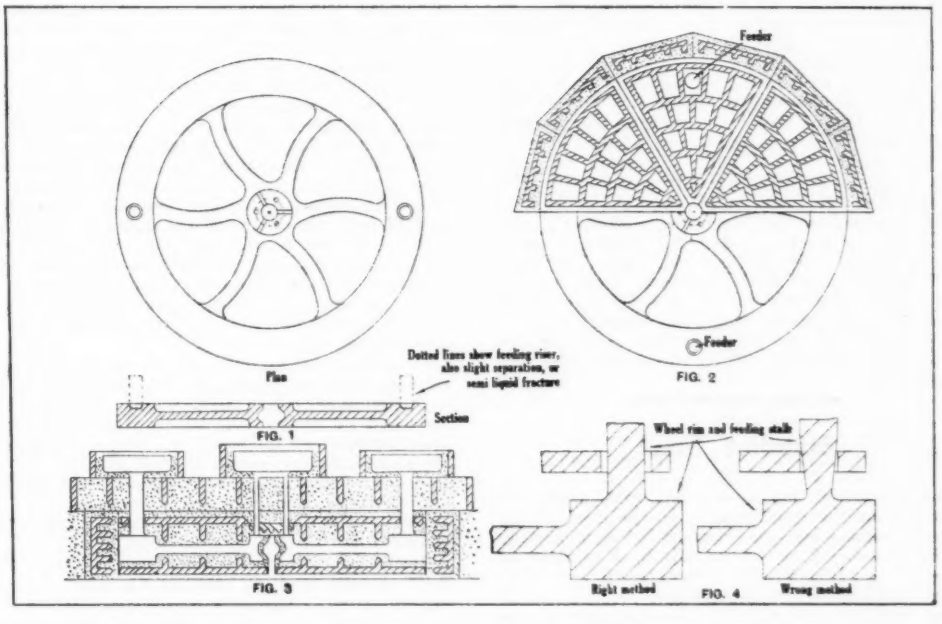
* Institution of Civil Engineers Abstract.

A Fly-Wheel Problem.

By S. G. Smith.

Foundry difficulties often come about even with the plainest castings. The example now under consideration has reference to fly-wheels for vertical gas-engines. The dimensions were 9 to 12 ft. dia., and a rim depth of 9 to 12 in., the hub being in proportion. The gross weight of the job was about 10 tons. Such a casting is shown in Fig. 4. The question of design of wheel does not have any bearing upon the matter, as the trouble was the repeated occurrence of what may be termed a semi-liquid fracture immediately underneath the two large feeders on the rim, shown in Fig. 2. In appearance they resembled a draw, which indicated that the rim of the wheel had not been sufficiently fed. What was quite certain, however, was that the metal must have been in the pasty stage at the time of separation, as the appearance of such a fracture is very pronounced.

Although this imperfection was not a serious one



the inspectors rejected every casting which developed any appearance of this slight separation.

It must be understood this type of fly-wheel was not new. Several had been previously made without this fault, which rather hindered than helped this investigation.

It may be interesting if reference is made to the method of moulding these castings. There is nothing new about the method, but descriptions of moulding operations are so rare, chiefly due to the amount of detail required to make the procedure intelligible.

Procedure.

The whole of the mould was formed with dry-sand cores as is shown in Fig. 3. A sand bed is levelled the depth of the assembled cores. The outside diameter of the rim is scribed on the bed with the tramel. This of course is a rough guide for the bottom layer of cores, which are the same diameter as the rim, and are six in number. When the joints of these are made good, the top layer of cores are put on, and matched up to the bottom layer. These twelve cores form the arms, hub, and rim. A series of circular cores now match up to the cores already assembled and forms the outside diameter of the rim. These cores are now rammed on the outside with floor sand to the level of the mould. The only remaining part now to be covered is the hub, or boss. After the splitting plates are fixed in the boss, and the centre core put into its print, the closing cake-core, which has the down-runner-gates rubbed in, registers into a seating formed on the six points of the top layer of arm cores. All that remains now is to complete the mould by ramming a plain top-box to cover the whole. The runner basins and risers are made, the mould weighted, and after pouring, the casting must be fed until almost solid.

The operations of assembling, pouring, and feeding were carefully noted, but nothing occurred from ordinary common foundry practice that gave a clue to the repeated trouble.

Now the time required to feed a casting sound of this description would be about thirty minutes. In case the feeding was done in an inefficient manner the writer took part with the feeding rods, and by means of very hot additional feeding iron at frequent intervals, also by raising the depth of the feeding head, and applying small pieces of aluminium to enliven the feeding iron, the time was extended to considerably more than an hour. If the occurrence again took place the cause of the defect was certainly not for the want of feeding. But the occurrence did take place again in very similar manner. Neither foundry foreman nor the moulders had any explanation to offer. The temperature of the iron when pouring, its quality and composition were all that could be desired.

Further Investigation.

The mould being formed by dry-sand cores (Fig. 2), attention was at once given to the core-making and core-irons, and here was found the first step to the solution.

When watching the core-irons being made for the top layer of cores, *i.e.*, the six cores which form the top half of the fly-wheel, it was noticed that all core-irons were alike; the writer asked the man making the irons (who, by the way, was a highly-skilled core-maker) which two of these core-irons were used for the location of the feeders on the rim. The reply was that either could be used for the feeders to pass through. It was at once ascertained the diameter of the feeding-stalk was such that it just passed through the opening allowed in the core-iron, on two sides (Fig. 4). No sand allowance existed between the feeding stalk and the core-iron, practically when the mould was poured it would be iron to iron. The core-maker was supplied with a feeding-stalk pattern to ram into two of these cores for feeding purposes. In the present case the diameter of the feeding-stalk would be about four inches. The core-maker admitted that if the feeding-stalk pattern passed through the opening in the core-iron he thought no harm could follow. However, this is only part of the solution.

As another of these moulds was at this time being assembled, the moulder was asked to show the writer the pattern of the feeding-stalk which was used for making up the feeding-riser.

It was found the diameter of this pattern was an inch larger in diameter than the feeding-stalk in the core. The way the moulder made an entry with the larger pattern into the smaller area in the core was by tapering the stalk pattern at the end with a pocket knife, and then rubbing the sharply tapered end of the stalk into the smaller area in the core. Thus when the wheel was cast, the feeding-stalk would be absolutely fast in the core-iron both sideways and on top.

When this mistake was pointed out to him and explained, he stated that it did not occur to him how that could cause the trouble. There may be some little excuse for the moulder, in view that he would not know exactly how much sand allowance there was around the stalk in the core, but admitting that, it was inexcusably wrong to taper sharply the stalk on the hard-baked core-sand.

Undoubtedly the following is what really happened:

When the mould was poured, and feeding proceeded with in the usual way for about 30 minutes, the feeding-stalk would be about 18 inches long, *i.e.* from the top of the wheel-rim to the bottom of the feeding-head. As solidification took place in the stalk, a slight contraction would naturally commence. Seeing that the feeding-stalk could not contract towards the casting as it should do, owing to being in direct contact with the core-iron, the pull, or contraction, however small, must come from the opposite direction, that is from the top of the rim of the wheel towards the feeding-stalk head. The very thick rim would naturally be in a pasty, or semi-liquid condition for some time, hence the slightest stress from the stalk which would now be set solid, would cause the slight separation or fracture, whether semi-liquid or otherwise. As the casting cooled this fracture owuld increase in size and depth, which would in this wheel be a circle about four inches diameter by an inch or more deep. When the core-iron opening was enlarged, and the sharp taper of the feeding-stalk used by the moulder was discontinued, no further trouble was experienced.

Stainless Steel

The subject of stainless steel, with particular reference to the applicability of the material in colliery engineering, was brought before a meeting of the Midland Institute of Mining Engineers at Barnsley by DR. W. H. HATFIELD (Brown-Firth Research Laboratories, Sheffield).

The speaker said that the development of the chrome steels as rust-resisting steels was quite recent, and the subject was one which, at the present time, was undergoing rapid development. The application of such materials by mining engineers in the various mechanical devices utilised in mining was naturally the care of the specialist. Each application of a new material to a specific purpose required special consideration.

Stainless steel was the name applied to a range of steels which belong to the iron-carbon-chromium alloys, the chromium in all of them ranging from 12 to 14.5 per cent. The percentage of carbon, manganese, silicon and other elements was controlled within desirable limits. As a result of research and works experiment, there were now available other stainless steels than the original one which was produced for cutlery and allied purposes, and which were only rustless in the hard condition. The material was now supplied in a high-tensile and machinable condition, simply required machining to shape, and was satisfactorily rust-resisting without further treatment. There was also a malleable stainless steel which had been evolved for the purpose of supplying a rust-resisting material chiefly in sheet form, which could be easily deformed cold, hammered, pressed, or drawn into the requisite shape, and only required polishing to produce a good surface. There was also the so-called stainless iron, which was a stainless steel in which the carbon content was reduced to a very low percentage. All these steels were manufactured by the electric process of steel manufacture, and required and received the careful subsequent manufacture which was necessary in the case of alloy steels.

Continuing, the speaker said the strength of stainless steel, as determined on the tensile testing machine, varied from over 100 tons per square in. breaking load in the hard condition, down to 30 to 40 tons per square in. when fully tempered. The lower figure corresponded to malleable stainless steel or stainless iron. A specimen series of figures obtained with a steel containing 0.30 per cent. of carbon, the test pieces being oil-quenched from 950 deg. C. (1,742 deg. Fah.) and then tempered, showed that the hardness and tensile strength were substantially maintained up to a tempering temperature of 500 deg. C. (932 deg. Fah.); higher tempering temperatures then resulted in a thorough tempering of the material down to very low tensile figures. Results obtained from the Izod impact test showed that as the material was softer, the impact value went up to a very high figure. Apart from the malleable form, stainless steel was almost invariably either used in the hardened and slightly tempered condition in which it had a tensile strength of about 100 tons per sq. in., or it was used in the well-tempered condition, when it had a tensile strength of about 50 tons.

Exhaustive fatigue tests had also been carried out on this steel in both these conditions, with the following interesting results. The tests were performed on the Wohler rotary fatigue-testing machine. The test piece was rotated horizontally at 1,500 r.p.m., with a load hung from one end. This load was changed for each test until a load was reached which just produced the stressing which the material would bear without rupture during 10 million revolutions. The results of the tests on stainless steel, in comparison with those obtained from an ordinary structural carbon steel, showed that mild steel could only be stressed alternately in tension and compression to between 11 and 12 tons per sq. in. if the material was to survive 10 million revolutions. In the 50-ton (well-tempered) condition, stainless steel would carry alternate tension and compression stresses of 21 tons per sq. in., whilst in the 100-ton (knife-temper) condition, this material would stand 32 tons per sq. in.

Stainless steel maintained its strength at high temperatures to a much greater degree than ordinary structural steel, and might therefore be employed with advantage where parts had to withstand stresses at temperatures above the normal. Moreover, experiments indicated that the energy absorbed in the notched-bar impact test was not substantially modified until temperatures approaching 600 deg. C. were attained. Above that temperature the values increased.

Regarding the resistance to scaling, Dr. Hatfield said that, in comparison with ordinary carbon steels, stainless steel resisted scaling to a marked degree with increasing temperature. Tests performed up to 1,000 deg. C. (1,832 deg. Fah.) on mild steel, alloy steels, tungsten steels, and stainless steel, showed that stainless steel scaled less than any of the others. The temper colours produced at much lower temperatures formed an analogous phenomenon to scaling, and it was well known that when hardened tool-steel was tempered, the originally bright surface went through a series of colours. During that process of colour-change with increasing temperature, the skin of the steel became seriously affected when visible red heat was attained. Stainless steel responded in a very different manner, and up to temperatures of 800 deg. C. (1,472 deg. Fah.) the effect on the surface was confined to the colour effect only. The same temper colours obtained during tempering, in the case of stainless steel, corresponded to much higher temperatures than in the case of carbon steel.

The ordinary methods of preparing steel surfaces should be employed with stainless steel. It should be pointed out, however, that grinding should always be done with water. If by an abrading action the temperature of the surface was unduly raised, the stainless properties were locally affected by the scorching effect thus produced. For the best results the surface should always be as good as could be commercially obtained. Nevertheless, it was not necessary to have a highly-polished surface for the material to be rust-resisting, provided all scale and pit-marks were eliminated.

Concluding, the speaker said it was quite clear that there were about a colliery many items which could usefully and economically be manufactured in stainless steel; for instance, boiler fittings, pump rods, pump cylinder liners, ropes, etc.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Cast Iron and its Chemical Composition.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I have read the first half of Mr. Smalley's paper in your issue of 4th inst. As you are aware, I seldom enter into correspondence of this nature, and do so now merely that this Paper may not pass without more comment than, I understand, took place at the actual reading of the paper in Newcastle.

Mr. Smalley starts by describing how fine or coarse graphite may be produced at will in cast iron, and he offers his descriptions as facts rather than as opinions. Considering the importance of the subject and the harm that might come about through the acceptance by foundrymen of anything not actually proved and therefore possibly incorrect, I may be forgiven for deploring the lack of evidence produced by Mr. Smalley to back up his case.

In plain language—Mr. Smalley says that large and coarse graphite in pig iron is more refractory than the finer varieties and, *therefore*, the coarse variety does not all dissolve in, or combine with, the iron in its passage through the cupola. *Hence*, he says, molten high-carbon grey irons melted in the ordinary way *always* contain some free graphite.

He says this is proved by pouring molten metal into cold water and finding free carbon in the solid iron. He does not state whether, by this means, he finds 1.0, 0.1, 0.01, or 0.001 per cent.—apparently the quantity is, in his opinion, unimportant to his arguments.

Also, he does not dwell upon the completeness or otherwise of his quenching operations. Without asking the many questions involved in his statement, I would desire to ask him for one plain statement to the following:—How much free graphite would he find in a small specimen of cast iron obtained by the following method? A cupola is melting an ordinary mixture of, say, half scrap iron and half pig iron, much of the latter containing coarse graphite; the metal is caught in a receiver and a little of it is tapped, from the bottom of the receiver, so as to pass instantaneously into and through a column of iced water; the cast iron containing about 3.35 per cent. total carbon and about 1.65 per cent. silicon.

From this point Mr. Smalley argues *that the obvious effect* is the reproduction in the cast iron of the coarse graphite in the pig iron. It *readily* explains, he says, the fine carbon produced by the addition of 10 per cent. of steel to any mixture; he also speaks as if the addition of 10 per cent. of steel *necessarily* produces fine carbon. In this connection he claims to have made thousands of tons of castings containing 0.67 to 0.74 per cent. combined carbon, 3.10 to 3.15 per cent. total carbon, 0.10 to 0.11 per cent. sulphur, and 0.65 per cent. manganese, giving between 14 and 19 tons per sq. in.—surely a record of "controlled compositions."

Further, he says that if pig iron containing large graphite be cast into chills the finer graphite thus produced will give rise to fine graphite in those castings made by remelting that same chilled iron. It is to be remembered that American practice has involved the use of much machine-made pig iron, but I think few of us have noticed that the average American casting is superior as compared with our own castings—I speak, of course, of cases where no steel is used and where the whole point is the difference caused by machine-made pig on the one side and by sand-cooled pig on the other.

Thus does Mr. Smalley solve most of the problems connected with the production of fine graphite and, in spite of the fact that it is of vital interest in the making of internal combustion and other important castings, he offers no convincing or scientific proofs whatsoever; as take, for instance, what he says about the temperature inside the cupola, the temperature attained by the metal in the cupola, the presence of free carbon in the molten metal, the reproduction in the casting of the coarse graphite in the pig, the prevention of this by chilling the pig, and so on. Mr. Smalley must forgive us if we cannot take his bare word for all these things; he may be perfectly right, but we need more than his own opinion that such is the case.

He continues, again with little or no analytical or physical data, by claiming to disprove the work of Moldenke and of Hatfield, condemning the results of the latter because he (Hatfield) does not mention that he took into account the casting temperature or the initial temperature of the mould. Thus does Mr. Smalley, after himself making all these remarkable assertions and giving no proof of any one of them, contemptuously dispose of another man's work on account of two omissions which it is a thousand to one Hatfield took into account quite as much as any other scientific worker might reasonably be expected to do.

To obtain good castings he gives the average casting temperatures for irons of various compositions, and he claims to show that the solidity of a casting containing 1.25 per cent. silicon and 0.2 per cent. phosphorus is rather better than that of one containing 2.20 per cent. silicon and 0.91 per cent. phosphorus.

In view of his definite claims as to casting temperatures, and the obtaining of fine graphite and solidity, etc., it is a fair question to ask him if the average castings produced in the foundries under his control are astonishingly better than those produced elsewhere, and if he has succeeded in almost eliminating failures? I do not wish him to answer this question; it is not a sporting one; but very certainly does Mr. Smalley lay himself open to questions of this nature.

The second half of Mr. Smalley's paper, as published in the JOURNAL dated May 11, gives further food for hard thought.

Having analysed some thousands of samples of cast iron, I know the difficulty of producing accurate analyses. Combined carbon, for instance, is a ticklish thing to talk about; it is generally necessary to estimate the total carbon and the graphitic carbon some five or six times before one has a result good enough and reliable enough for purposes of research work.

Table III. of Mr. Smalley's Paper shows five irons used by him to prove that low-silicon-low-phosphorus iron is a better casting metal (see Fig. 10, No. 3) than high-silicon-high-phosphorus metal (see Fig. 10, Nos. 1 and 2). Mr. Smalley does not, however, point out that, no matter the percentage of silicon and phosphorus in his samples, that of the combined carbon is not dissimilar save in the one sample, No. 2. These five analyses are extremely puzzling and need much explanation before going on to any agreement or disagreement with the work of Professor Turner or even to the question of solidity.

Throughout the second half of this Paper, I find the greatest difficulty in appreciating the analyses given by Mr. Smalley. Moreover, supposing the analyses to be correct, then it would seem to follow that the conditions have been abnormal and that the metals cannot be used to prove the effects upon solidity of different compositions. With few exceptions is the main composition of cast iron reflected by the amount of combined carbon.—Mr. Smalley's irons appear to belong to the exceptions.

In Table III. Mr. Smalley is using irons varying from 3.1 to 3.9 total carbon*, 1.1 to 2.5 silicon, and 0.09 to 1.54 phosphorus. Surely too many and too great variables for one small experiment upon only five irons. What conclusions can one draw from such a conglomeration of variables and from so few results?

The Paper is a thousand papers rolled into one! It deals with and disposes of apparently anything or anyone! Yet I do not for one minute believe Mr. Smalley had any such intention, and probably offers his few results in a very tentative spirit—but it does not appear so in his Paper.

Take his physical tests. Is he aware that other workers have done a great deal of work upon similar lines and that in most instances their results are dissimilar to the few shown here. What are the relative values of Mr. Smalley's work and that of other workers? Did Mr. Smalley

* According to the Paper, these figures should read 2.88 to 3.43 per cent. total carbon.—ED.

repeat his tests, and were the repeats always confirmatory of the originals? How did he do them? Nothing is told to us of these things, but according to the general tenor running throughout the Paper we may take it that Mr. Smalley's results are the correct ones and other workers are labouring under a mistake.

Mr. Smalley is a neighbour of mine although I do not know him yet. In many ways I admire his zeal, but think he has attempted too much and proved too little. Moreover, his remarks about the work of Moldenke, Hatfield, Turner, etc., appear to be totally uncalled for and *infra dig.*—they serve merely to lay his Paper open to criticism such as my own.

I have often said that I know very little about cast iron, but, on the other hand, I have had a good deal to do with it, and Mr. Smalley's flowing account of "How it works" tempts me to write a whole volume of criticism in detail . . . but any metallurgist, familiar with cast iron, could do so upon this Paper fairly bristling with problems.

At the beginning of his discourse Mr. Smalley says:—"If steel is melted with cast iron in a correctly designed cupola, using the correct volume of air and is suitably fluxed, etc." I would suggest to him that a paper upon what is a *correctly designed* cupola, the *correct volume* of air, and *suitable* fluxing, would be highly interesting to foundrymen and chemists—not to speak of the many makers and users of different designs of cupolas and blowing apparatus here and abroad.

There is one subject upon which Mr. Smalley dwelt without castigating anybody, and the fact leads me to ask whether he is a follower of one of the well-known correspondence courses.

I trust Mr. Smalley will take my criticisms in good part, and that he will give us many further papers, each dealing with one, and one only, of the many doubtful points occurring in this one. I have not contradicted him upon any point; he has gone too fast to admit of any definite argument, and I have little doubt but that he has touched upon the truth in several instances. Therefore, let him linger long enough to prove some of these things to us in order that we may criticise his science rather than his impetuosity.

I have no intention of entering into any further correspondence, but I hope you will allow Mr. Smalley a fair opportunity of replying to my frank criticisms which, I assure him, are intended to carry no personal qualities whatsoever; my one personal remark being that he is evidently a keen and sincere person with whom I hope to get better acquainted.—Yours, etc.,

Horace J. Young, F.I.C.

Laboratory,
Northumberland Engine Works,
Wallsend-on-Tyne.

May 16.

The Origin of Defects in Tube Rolling.*

In manufacturing tubes by the Mannesmann process, with oblique rolls, cracks and hollows are produced, which are mostly closed by welding in a later phase of the rolling. The author has investigated these defects, and he found that when operating on both longitudinal and cross sections of round ingots, without rolling over the core-bar or mandrel, no structural fracture occurred, but merely slight disintegration of the material which diminished from the core outwards and seemed to follow no rule. He considers, therefore, that the defects are not a specific consequence of oblique rolling. They appear first just in front of the mandrel point, where the disintegration referred to occurs. The participation of the mandrel in producing the defect is stated to be proved by the manner and degree of wear exhibited by the mandrel point, shown in an illustration, over which point the metal is, in a measure, disintegrated by the axial and tangential roll-pressure, and then welded together. The problem is discussed theoretically and practically, with the aid of diagrams and tables of results of tests, and specimens of sound and defective tubes are illustrated.—J. Gassen (*St. und Eis.* 41, 1767-1771.)

* Institution of Civil Engineers Abstract.

A Journal of Scientific Instruments.

The Institute of Physics, impressed with the need of a journal dealing with methods of measurement and the construction and use of instruments, has under consideration the publication of a journal bearing the above title. In Germany there are some four or five journals which cover this field, and one of these, which devotes itself entirely to the subject of scientific instruments, has been of great influence in imparting a sense of the importance of scientific methods in the study of technical and industrial problems. Incidentally it has been largely instrumental in fostering the scientific instrument trade of the country.

Research workers and manufacturers in this country have long felt the need of such a journal, for although descriptions of instruments and methods of measurement are published in the specialised journals and in the Transactions of learned societies, emphasis is not as a rule laid on the construction of the instruments, nor are detailed drawings generally reproduced. Still less does one find an indication of possible applications of an instrument or method in a field other than that for which it was originally devised. Physical measurement is the basis of all exact scientific and industrial work, and a journal of the proposed scope will not only be of direct value to the research worker in physics, chemistry, engineering, biology, and medicine, but it will also materially aid manufacturers of scientific instruments and act as an incentive to invention and progress.

The journal will be managed by a committee appointed by the Institute of Physics, on which the Department of Scientific and Industrial Research and the National Physical Laboratory will be represented, and the editorial work will be carried out at the National Physical Laboratory, assisted by a scientific advisory committee appointed by the Institute of Physics. It will probably consist of thirty-two pages, and will be published monthly at 2s. 6d. per issue. The Institute will only find it possible to make itself responsible for the journal if its financial position is secured; and as a means of ascertaining what support may be expected a specimen number for free issue is now being issued. Anyone desirous of obtaining a copy of this number is asked to apply to the Secretary of The Institute of Physics, 10, Essex Street, London, W.C.2, and to enclose 6d. to cover postage.

Rapid Electro-Analysis of Brass.*

The method of proving by electrolysis the percentage of copper in brass has been long established. The authors have endeavoured to extend this process in order to prove the percentage of zinc in the residue, following the deposition of the copper. The main difficulty in this is due to the presence of nitric acid, necessary for the solution and deposition of the copper. It is claimed that a satisfactory routine has been established by which the weight of both copper and zinc can be ascertained from an appropriate sample, within 1½ hr.

The process depends upon the limitation of the quantity of nitric acid used: this is removed by electro-decomposition after the removal and weighing of the copper. The residue is treated with soda and acetic acid, and also with sodium fluoride to control any iron present; the zinc is deposited upon a rotary electrode coated with copper.—A Lassieur and — Lassieur. (*C.R.* 175, 772-775.)

Christmas, Hulbert & Walters, Limited, are supplying R. D. Wood heavy duty type "Automatic" gas machines to Taylor Brothers & Company, Limited, Trafford Park Steelworks, Manchester. The original contract for one machine has since been extended, officials of Taylor Brothers & Company, Limited, having studied various R. D. Wood installations in the United States. These machines will supply gas to existing open-hearth melting furnaces, and will gasify from 30 cwts. to two tons of coal per hour per gas machine. The company's mill type of machine is built to gasify one ton of coal per hour.

* Institution of Civil Engineers Abstract.

Trade Talk.

BEYER, PEACOCK & COMPANY, LIMITED, propose to purchase one-third of the outstanding debenture stock at £80 per cent.

BRUNNER, MOND & COMPANY, LIMITED, have decided, for financial and industrial reasons, not to establish works in Australia.

JOHN MARSDEN & SONS, electrical engineers, Aspinall's Yard, Market Place, have removed to 1, Upperhead Row, Huddersfield.

THE RAMSAY CONDENSING LOCOMOTIVE COMPANY, LIMITED, have established a branch at Millgate Buildings, 18, Long Millgate, Manchester.

THE VIDAL ENGINEERING COMPANY, of Thornton Road, Croydon, are now affiliated to the Association of British Machine Tool Makers, Limited.

THE THORNECLIFFE IRONWORKS of Newton, Chambers & Company, Limited, have been closed down until a settlement of the engineering dispute is reached.

H. B. CLAY & COMPANY, 246a, Corporation Street, Birmingham, have been appointed sole Midland agents for B.S. Machine Tools, Limited, 111, Salisbury Road, London.

MR. H. T. MIDDLETON, iron and steel merchant, 39, Great Tower Street, London, E.C.3, has been appointed sole British agent for Fonderie de L'Ancre, of Marcinelle.

MR. PHILIP CHAPMAN has established himself in business at 5, Copthall Buildings, Copthall Avenue, London, E.C., as exporter of metals, tools and machinery, etc.

THE SHIPYARD TRADE UNIONS, the members of which are still remaining on strike in the non-federated ship-repairing centres in London and Liverpool, have decided to stop strike pay.

ALFRED HERBERT, LIMITED, have been appointed sole agents in Japan, Manchuria, Korea, and Formosa, for the power presses manufactured by John Hands & Sons, Limited, Birmingham.

THE quarterly meeting of the Federated Associations of Scrap Iron, Steel, Metals and Machinery Merchants of Great Britain will be held on Thursday, May 25, at the offices in Manchester.

R. & W. HAWTHORN, LESLIE & COMPANY, LIMITED, of Newcastle, are preparing to build the Diesel engine at their St. Peter's works. Extensive alterations are being carried out for the purpose.

SANDERS BROS. & COMPANY, LIMITED, 10, Bush Lane, Cannon Street, London, E.C.4, have been appointed British agents for the Wickwire Spencer Steel Corporation, Worcester, Mass., U.S.A.

LICENCES under the Non-Ferrous Metal Industry Act, 1918, have been granted to J. Downey, St. Stephen's Street, Devonport; and Van Perlstein & Munro, Dunster House, Mincing Lane, London, E.C.3.

J. W. SINGER & SONS, LIMITED, iron and bronze founders, of Frome, Somerset, have removed their London office from Effingham House, Arundel Street, W.C.2, to 8, Bathurst Street, Lancaster Gate, London, W.2.

THE BOARD OF TRADE have appointed Mr. H. Birtles, the Registrar of Joint Stock Companies, and Mr. A. E. Campbell-Taylor, the Assistant Registrar, to be Registrar and Assistant Registrar of Business Names respectively.

THE ETABLISSEMENTS A. UTARD have opened at Longueville-en-Barrois (Meuse) a demonstration foundry for the purpose of giving facilities to prospective buyers of seeing their various makes of moulding machines in actual operation.

MR. CHARLES PALLISTER has joined the board of directors of A. J. Luck & Company, Limited, metal and mineral merchants, 37, Hatton Garden, London, E.C.1, and the firm will in future carry on business under the style of Pallister, Luck & Company, Limited.

THE BUSINESS of the A-1 Manufacturing Company, Sunbridge Road, Bradford, has been acquired by the A-1 Electric Welding Appliances Company, and the former firm's welding and heating machines will in future be manufactured at the Inverness works of the latter company.

AT the meeting of the Institution of Mining and Metallurgy on Thursday of last week the following papers were submitted for discussion :—"The Treatment of Pyritic Concentrates containing Tin," by Mr. C. W. Gudgeon, and "Clean Reef-Mining and Its Influence on Mining Costs," by Mr. L. G. Hutchison.

MR. C. L. MACCARTHY, formerly of Stewarts & Lloyds, Limited, has opened offices at 48, Foster's Buildings, Sheffield, and will represent throughout the coalfields of Yorkshire, Derbyshire and Nottinghamshire, Milner Hurd's Patents Company, Limited, of 4, Paradise Square, Sheffield.

IN consequence of the possibility of the French Government increasing the import duties on steel, the Sheffield Chamber of Commerce has communicated with the British Chamber of Commerce in Paris which, in turn, has referred Sheffield's plea for special consideration to the Inter-Ministerial Commission.

WITH THE RECENT REDUCTION in railway rates the use of home ores is once more within the range of practicability. The Ebbw Vale Steel, Iron and Coal Company, Limited, are now proposing to use the stone from their extensive mines in Northamptonshire for making basic steel, and some tests have been made of late in this direction, which are stated to be quite satisfactory.

THE UNITED STATES SENATE has adopted a resolution ordering an investigation into the pending merger of the Lackawanna Steel Company, hitherto independent, with the Bethlehem Steel Corporation. Mr. Taylor, the chairman of the Lackawanna Company, has announced the completion of the negotiations for the merger of his company with the Bethlehem Steel Corporation.

BROWN, LENNOX & COMPANY (LONDON), LIMITED, Millwall, London, E.14, have taken an order from one of the leading oil companies for five of their patent pressed steel sectional tanks, each measuring 80 ft. x 44 ft. x 12 ft. deep, and having a total capacity of 1,320,000 gallons. The aggregate weight is 275 tons, and 74,000 ⅞-in. bolts will be used in making the joints.

I.B.F. President's Visit to America.

Mr. Oliver Stubbs, president of the Institution of British Foundrymen, and Mr. Thomas H. Firth, a past-president, arrived in Detroit on May 1, and made a round of the more important manufacturing plants in and near Detroit, leaving on May 4. Several social events were arranged in their honour. The party proceeded to Pontiac, to visit the Wilson Foundry and Machine Company, and from there to Flint to visit the Buick plant. Mr. H. M. Lane, representing the Detroit Foundrymen, met the visitors in Cleveland, and accompanied them to this city. A banquet in the Detroit Athletic Club was held in the evening, prominent steel men, foundrymen, and manufacturers being present.

The visitors left Detroit, accompanied by Sir Henry Hollingdrake, for Chicago on May 4, after three days of busy sight-seeing and studying of American methods in foundry work and automobile manufacture. They will visit New England after a short stay in Chicago. Thirty-five foundrymen and manufacturers attended the dinner at the Detroit Athletic Club.

In an address at the banquet Mr. Stubbs, commending American foundrymen and manufacturers for the development of their methods, said that many ideas which have worked out successfully there may be incorporated in English factories and foundries. He expressed the opinion that America was making a critical mistake in failing to be present at the Genoa Conference, and suggested a conference of American and British business men and manufacturers as a possible stepping-stone to better relations between the countries, and as helping to solve the finance problem of Europe.

"Having all the gold here will not do the United States any good when it is considered that then Europe would not be able to purchase anything from America," he said.

The visitors inspected the Dodge and Packard plants, the Wilson Foundry and Machine shop in action at Pontiac, and Mr. Henry Ford's latest acquisition, the Lelands' Lincoln Motor plant.

On May 6 Chicago foundrymen, appreciating the visit of Mr. Oliver Stubbs, tendered him a dinner at the Union League Club, on the occasion of his visit to this city. The guests numbered twenty-three, and included members of the American Foundrymen's Association in Chicago and Milwaukee. Mr. C. R. Messinger, vice-president of the American Foundrymen's Association, presided. An address of welcome was made by Mr. John W. O'Leary, of the Chicago Trust Company, to which Mr. Stubbs made suitable response, speaking feelingly of the many courtesies extended him by American foundrymen ever since he landed in New York. Mr. Charles Piez, of the Link-Belt Company, spoke along the lines of industrial relations, giving some of his experiences in connection with the Emergency Fleet Corporation during the war. Major R. A. Bull, of the Electric Steel Foundries Research Group, was also called on, and at his suggestion the remainder of the evening was spent in informal questioning and answering between Mr. Stubbs and the other foundrymen.

Company News.

Blyth Shipbuilding & Dry Docks Company, Limited.—Interim dividend, 6d. per share, less tax.

John I. Thornycroft & Company, Limited.—Interim dividend, 3 per cent. on cumulative preference, less tax.

Park Electrical & Engineering Company, Limited.—Capital £10,000 in £1 shares. Registered office: Ashburton Road, Trafford Park, Manchester.

George McCombe & Company, Limited.—Capital £2,500 in 2,300 preference of £1 and 200 ordinary of £1. Engineers. Directors: J. K. MacDonald and R. Cunningham.

Stamford Engineering Company, Limited.—Capital £1,000 in £1 shares. Directors: D. Stevens and Mrs. R. Stevens. Registered office: 400, Hoe Street, Walthamstow, E.17.

Holes, Limited.—Capital £1,500. General engineers, manufacturers of engines, etc. Directors: N. H. Everitt, S. H. Hole, and C. Hole. Registered office: 61, Union Street, Ryde, I.W.

Beltoid Manufacturing Company, Limited.—Capital £2,500 (2,000 5 per cent. participating preference shares of £1, and 10,000 ordinary shares of 1s.). Engineers, etc. Permanent governing directors: C. W. Taylor and A. R. Kearney.

G. Robinson & Company, Limited.—Capital £5,000, in 4,975 six per cent. cumulative participating preference shares of £1, and 500 ordinary of 1s. Brass workers, etc. Director: R. Hilton. Registered office: Andrew Place, Cowlthorp Road, Wandsworth Road, S.W.

Brooks & Doxey, Limited. — Net profit, £137,827; dividend and bonus paid in March, 1921, £49,984; interim dividend and bonus declared in February, £32,203; final dividend, 9d. per share, tax free; bonus, 9d. per share, applied in payment of uncalled capital, making shares 17s. 3d. paid; carried forward, £12,702.

The Titan Crane, Limited.—Capital £10,000 in £1 shares. Signatories:—T. E. Thirlaway, Shipyard, Wallsend-on-Tyne, and A. J. C. Ross, St. Peter's Works (director of R. and W. Hawthorn, Leslie & Company, Limited). Swan, Hunter and Wigham Richardson, Limited, and R. and W. Hawthorn, Leslie & Company, Limited, may each appoint one director. Registered office: Wallsend Shipyard, Wallsend-on-Tyne.

Babcock & Wilcox, Limited.—Net profit, £490,181; brought forward, £99,827; interim dividends paid November 3, 1921, 3 per cent. on preference shares, 2½ per cent. on second preference, and 7 per cent. on ordinary shares; balance, £432,114; final dividends, 3 per cent. on preference, 2½ per cent. on second preference, both less tax, and 9 per cent. on ordinary (free of tax); reserve fund, £150,000; staff pension fund £10,000; carried forward, £71,243.

Publications Received.

"A Chart of American Rolling Mill Practice," by the Bethlehem Steel Company, and obtainable at 9s. 6d. from their London Agent, Z. M. Grant, 40, Bessborough Street, Westminster.

This chart has been worked out and copyrighted by Charles E. Lehr, chief engineer, and W. J. Phillips, chief draftsman, of the Bethlehem Steel Company, Bethlehem, Pa.

The chart, beginning with two sizes of ingots, traces the reduction of the ingot to billets, and thence the further rolling to finished products. The feature of the chart, which covers thirty-two different rolled shapes, is that besides indicating the shape of each succeeding cross-section of the rolled product, the area, and therefore the reduction from the preceding pass and the elongation, are enumerated. These sectional diagrams naturally indicate what are the profiles of the rolls. The finished sections include a rim section, window sash, turbine blade, 100-lb. rail, sheet piling, and various common structural and bar sections. Incidental are some illustrations showing the main apparatus, such as the equipment used in a rolling mill and typical lay-outs of the general types of rolling mill.

The chart is 23¼ by 41¼ in.

A Little Journey to the Homes of Soldiers and Sailors Blinded in the War, being the 7th Annual Report of St. Dunstan's Hostel and After-Care Organisation. This booklet contains an interesting record of the excellent work carried on by the late Sir Arthur Pearson's organisation familiarly known as St. Dunstan's.

Messrs. Staveley Coal & Iron Company, Limited. Monthly stock list of cast-iron pipes for May.

Gazette.

Mr. E. J. Trawford, tube manufacturer, late of the Springfield Works, Darlaston, has been adjudged bankrupt.

A receiving order has been made against Mr. H. Mote, metal merchant, formerly of 434, Foleshill Road, Coventry.

The Aluminium Alloy Pistons, Limited, have decided to wind up voluntarily, and Mr. A. Walton, of Leeds, has been appointed liquidator.

The partnership heretofore subsisting between Messrs. W. Taylor and W. S. Hubbard, engineers, Kent Street, Leicester, under the style of Taylor & Hubbard, has been dissolved.

The Coventry Nut and Bolt Manufacturing Company, Limited, have passed a resolution to wind up the company, and have appointed Mr. M. G. Dadley, Hertford Street, Coventry, liquidator for that purpose.

Messrs. A. Dickson, D. Williams, W. Flitcroft and W. Austin, brass moulders, Victoria Foundry, Elton Street, Lower Broughton, trading under the style of Dickson, Flitcroft & Company, have dissolved partnership.

The partnership heretofore subsisting between Messrs. J. A. Woolley and W. H. Parsons, nail and hardware factors, 20, Sand Street, Birmingham, under the style of A. Evans & Company, has been dissolved. The business will in future be carried on by Mr. W. H. Parsons.

Deaths.

Mr. C. G. Robertson, manager of the engine works at Barrow of Vickers, Limited, died on May 1.

Mr. Percy Wood, a director of Lumby's, Limited, boiler makers, of West Vale, near Halifax, died recently.

Mr. F. M. Bonnell, formerly of John Bonnell & Sons, Longford Iron & Steel Works, Warrington, died recently at the age of 66.

Mr. R. Gildart, formerly head of R. Gildart & Sons, machinery and metal merchants, of Blackburn, from which firm he retired a few years ago, died recently.

Personal.

The late Mr. I. Levy, of Primrose Lodge, Lamdon Hill, Essex, retired metal broker, left £9,058.

The late Mr. E. W. Neems, senior partner of E. W. Neems & Company, metal brokers and merchants, Fenchurch Street, E.C., left £9,813.

Mr. J. McLean McKnight, of Glasgow, has been appointed assistant lecturer in engineering for South Staffordshire under the County Education Committee.

The late Hon. Edward Christian Kitson, chairman of Kitson & Company, Limited, Airedale Foundry, Hunslet, Leeds, left unsettled estate of £90,247, with net personalty £79,339.

Mr. T. W. Hodges, the North-East Coast agent of the Consett Iron Company, Limited, has been the recipient of a presentation in commemoration of his jubilee of service with that firm.

Sir Archibald John Campbell Ross, a director of R. and W. Hawthorn, Leslie & Company, Limited, is the new president-elect of the North-East Coast Institution of Engineers and Shipbuilders.

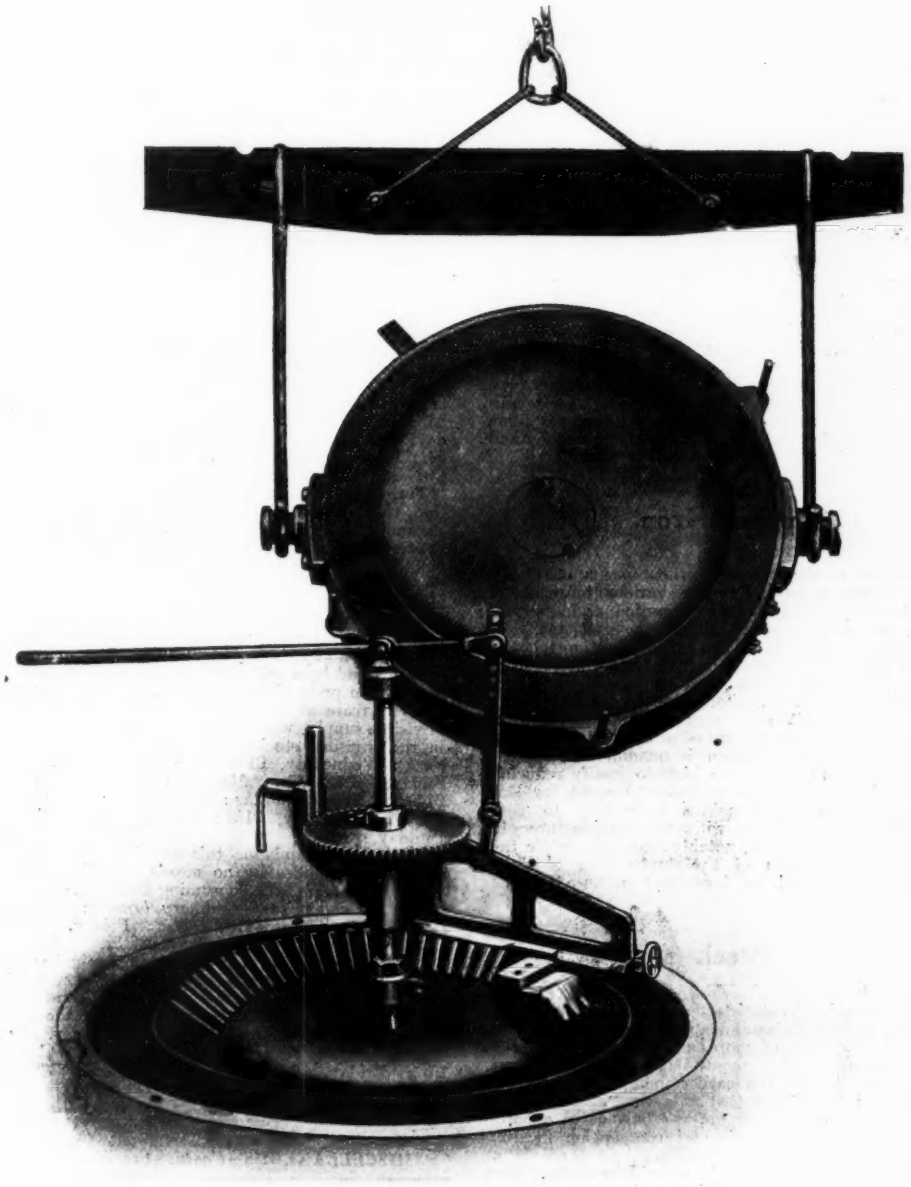
Installation of Machinery for the Birmingham Exhibition.

Messrs. Day Brothers, of New John Street, Birmingham, have been approached by the Birmingham Chamber of Commerce with a view to procuring their services for exhibitors for the unloading, moving and installing of the exhibits at the forthcoming exhibition in June.

Electro-Deposition of Iron.—In view of the extended use of electro-deposited iron for many industrial purposes, the Department of Scientific and Industrial Research has considered it advisable to issue a bulletin (No. 6) which embodies the results of research carried out by Mr. W. E. Hughes, with the assistance of grants made by the Department. The contents of the report are arranged under the following headings among others:—(1) Introduction. (2) General note on the description of the deposits: (*a*) On the effect of temperature; (*b*) current density; (*c*) mechanical movement. (3) Introduction to theoretical part. (4) The crystallisation of substances in general. (5) Application to electro-deposited metal. (6) Workshop application. (7) Bibliography.

The "VULCANIA" PATENT WHEEL MOULDING MACHINE.

Patent No. 5049.



THE "VULCANIA" PATENT WHEEL MOULDING MACHINE is for moulding spur wheels with straight, sloping or Vee-shaped teeth, also bevel wheels, skew gear wheels, worm wheels and internal wheels. The machine head is carried on a pillar which is held in a base-plate bedded in the floor sand, and is made to slide on the pillar by means of a lever and link carried on a joint bearing, or by rack and pinion, or screw if thought advisable for the particular work it is being used for.

An adjustable stop collar is provided for accurately deciding the depth of mould. On the removable head a slide is carried for supporting the patterns of the teeth to be moulded. This slide is made adjustable by screw or pinion gearing to the diameter required. The number of teeth to be moulded is decided by a special dividing plate into which a steel wedge or finger engages. The special dividing plate has milled vees, at the angle of 60° inclusive, around its circumference, to receive the steel wedge, which is adjusted by a screw having an internal spring to keep it in tension and to lock the head when ramming operations are being carried out.

JAMES EVANS & CO., BRITANNIA WORKS,
(MANCHESTER), LIMITED,
BLACKFRIARS, MANCHESTER.

IRON AND STEEL MARKETS.

Pig-iron.

Reports from the chief centres of pig-iron production indicate continued suspension of business as concerns home consumers, and were it not that export trade is fairly active the outlook might well be regarded with a greater degree of pessimism. Obviously, the unsettled conditions in the more important consuming industries is the main contributory cause of the present stagnation, and until that trouble is finally solved, it is hopeless to expect a permanent improvement. The Midlands, in this connection are, perhaps, more affected than other iron-making centres on the coast, the heavy transport charges, only partially lightened by the recent reduction in rail tariffs, making competition for export trade extremely difficult. It is satisfactory, however, to learn that there has been, so far, no reduction in the number of Midland furnaces in operation, with quotations remarkably steady for the leading brands, Derbyshire No. 3 foundry still being obtainable at 82s. 6d., with forge at 75s., and Northamptonshire makes respectively 77s. 6d. and 70s. for similar qualities. Movements in Scottish pig-iron markets are equally affected as elsewhere by adverse trade conditions, but here, again, the export outlet affords some scope for the disposal of outputs, about a thousand tons of metal having been shipped last week.

Finished Iron.

Although for the present without signs of immediate recovery, prospects in the various branches of the finished iron industry are regarded as more promising, and if, as is unfortunately the case, many of the works are wholly or partially idle, the tone of markets suggests an early revival of more active conditions. Makers of marked and the commoner qualities of bars in South Staffordshire report little fresh business passing, although in many cases either working at a loss or a bare margin of profit, and in finished iron circles generally opinion is unanimous that the cost of production is still too high to justify reducing prices to levels likely to stimulate demand for this class of material. Iron makers have also to contend with keen competition with steel manufacturers in certain classes of products, notably gas strip, while the extended closing down of the shipbuilding industry has further restricted an important outlet for the material.

Steel.

The interruption to steel trade expansion, consequent upon the current labour disturbances, continue to hamper development of more active conditions, the export returns for last month showing a falling-off when compared with the earlier months of the year. This is much to be regretted at a time when Britain was rapidly recovering her pre-war balance of exports over imports. Fresh Continental competition in iron and steel is likely to be in evidence, as there is a growing accumulation of stocks at various works. For this reason there is a disposition on the part of Continental producers and sales agencies to attempt to regain their position in the British markets. Business in home constructional steel is on a disappointing scale, while the crucible branch, just recovering from a long spell of stagnation, has had another set-back. Buying on oversea account is by no means so brisk as was anticipated recently, and is probably withheld in the expectation that more advantageous terms may be on offer when conditions become more settled. The steel foundries are far from busy at the moment, while the long delayed orders for railway steel and materials are beginning to materialise, but are not, so far, on the scale anticipated.

Scrap.

Business in all kinds of scrap metal continues practically at a standstill. The stagnation in the consuming trades having for the time being terminated active buying and selling. In the Cleveland market the following are the approximate current prices, delivered at works:—Heavy steel scrap, 60s. to 62s. 6d.; steel turnings, 42s. 6d. to 45s.; cast-iron borings, 42s. 6d.; heavy wrought-iron piling scrap, ordinary quality, 62s. 6d.; ditto, bushelling, 62s. 6d.; ditto, heavy forge, 65s.; cast-iron machinery in handy pieces, 82s. 6d. to 85s.; cast-iron scrap (ordinary quality), 75s. to 77s. 6d.

Tinplates.

Conditions in the tinplate market of late reflect some relaxation of the active buying of a few weeks' ago, but the majority of makers are well-booked over the remainder of the half-year, and outputs are maintained for the present. Prices continue round about previous levels, with current quotations ruling—I C 14 x 20, 112 sheets, 108 lbs., 19s. 3d. to 19s. 6d. per box; I C 28 x 20, 112 sheets, 216 lbs., 38s. 3d. to 38s. 9d. per box; net f.o.b. Wales. For terneplates quotations are 17s. 6d. basis and upwards, net f.o.b., but not much new business is reported.

Metals.

Copper.—During the past week the steadiness previously noted in the standard copper market has been well-maintained, but buying has been mostly on a hand-to-mouth scale, with a fairly large turnover each session. Consumption of this metal is undoubtedly on the increase, if slowly, there having been a fair demand for rough copper here, and in America for refined descriptions, accompanied by firmer prices. Speculative business is again in evidence, operators mostly favouring dealings on forward account. Closing prices.—*Cash*: Wednesday, £61; Thursday, £61 16s. 3d.; Friday, £62 2s. 6d.; Monday, £61 17s. 6d.; Tuesday, £62 2s. 6d. *Three months*: Wednesday, £61 3s. 9d.; Thursday, £61 17s. 6d.; Friday, £62 5s.; Monday, £62 5s.; Tuesday, £62 10s.

Tin.—With an improved demand for home consumption, the position in the standard tin market has been distinctly firmer, with values showing a steadily advancing tendency. Inquiries for both spot and forward metal have been in better volume of late, Messrs. Henry Bath & Son, Limited, stating in their fortnightly report that advices from America are favourable in spite of the coal strike there. At the same time shipments from the East this month promise to be heavy, and it seems doubtful if the deliveries in America and here will prove to be on an equally large scale. The probability, therefore, is that there will be some increase at the end of the month in the figures of visible supply, which may be balanced by a decrease in the invisible stocks in the East. Closing prices.—*Cash*: Wednesday, £148 15s.; Thursday, £150 5s.; Friday, £152 10s.; Monday, £150 10s.; Tuesday, £149 15s. *Three months*: Wednesday, £150; Thursday, £151 15s.; Friday, £154; Monday, £151 17s. 6d.; Tuesday, £151 5s.

Spelter.—Demand for this metal continues fairly good, with supplies by no means excessive. The galvanising trade is still consuming freely, and prices are firm. Closing prices.—*Ordinary brands*: Wednesday, £27 2s. 6d.; Thursday, £27 5s.; Friday, £27 5s.; Monday, £27 7s. 6d.; Tuesday, £27 5s.

Lead.—The market for soft foreign pig has shown little change of note, a steady turnover of metal being maintained with prices firm for prompt and forward deliveries. Stocks in hand are still below the average. English lead prices show an upward tendency. *English closing prices*: Wednesday, £25 5s.; Thursday, £25 10s.; Friday, £25 15s.; Monday, £26; Tuesday, £26 5s.

MISCELLANEOUS—*Contd.* *See also page* 18.

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